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In the Specification:

Please amend the paragraph at page 4, line 27, to page 5, line 10, by substitution as follows:

One preferred embodiment of the invention shown in FIGURE 1 is illustrated in FIGURES 2 and 2A-2H. In this embodiment, the sensors S1-S96 are divided into 16 sensor groups of 6 sensors each. A first sensor group 301 is shown in FIGURE 2A. The sensor group 301 is optically closest to the lasers L1-L6 and to the processing electronics 200. The first sensor group 301 is coupled to the six distribution fiber lines DF1-DF6 through which the input optical signals are carried. The distribution fiber lines DF1-DF6 are connected to respective standard 1 × 2 input couplers 320 which in turn are connected to sensors S1-S6. The input couplers 320 couple a fraction of the input signal to their respective sensors S1-S6 and pass the remaining optical signal onto other couplers 320, although for some applications the first sensor group ~~300~~301 alone (without additional sensor groups) may be utilized, in which case the coupling ratio for each of the input couplers 320 is 100%. In the embodiment shown in FIGURE 2, however, the coupling ratio for the input couplers 320 of the first sensor group ~~300~~301 is selected to be 3.5%, with the remaining fraction (96.5% minus any excess losses) of the input signals propagating towards the other sensor groups.

In the Claims:

Please amend claims 1, 4, and 9-10 by substitution as follows:

1. (Once amended) An m × n sensor array, comprising:

m distribution fiber lines;

n return fiber lines; and

~~n~~z sensor groups, each of said ~~n~~z sensor groups comprising:

~~m~~y sensors; and

input couplers and output couplers, said input couplers and said output couplers being connected to respective ones of said sensors, each of said input couplers within any one of said ~~n~~z sensor groups being connected to a different one of said m distribution fiber lines;

wherein each of said return fiber lines is connected to all output couplers within a respective one of said ~~n~~z sensor groups; ~~and~~

wherein coupling ratios of said input couplers in said ~~n~~z sensor groups and coupling ratios of said output couplers in said sensor array are chosen to reduce differences in the returned optical signal power levels, ~~and~~ wherein the coupling ratios of said output couplers connected to a respective return fiber line are different from each other; and

wherein said output couplers comprise a first output coupler and a second output coupler, wherein a first number of said output couplers are located between said first output coupler and a signal destination on one of said n return fiber lines, wherein the first number is greater than or equal to zero, wherein the coupling ratio of said first output coupler is based on the first number, wherein a second number of said output couplers are located between said second output coupler and the signal destination on the one of said n return fiber lines, wherein the coupling ratio of said second output coupler is based on the second number, wherein the second number is greater than the first number, wherein the coupling ratio of said second output coupler is larger than the coupling ratio of said first output coupler.

4. (Twice amended) A sensor array, comprising:

distribution fiber lines;

return fiber lines; and

sensor groups, each of said sensor groups comprising:

sensors; and

input couplers and output couplers, said input couplers and said output couplers being connected to respective ones of said sensors, each of said input couplers within any one of said sensor groups being connected to a different one of said distribution fiber lines;

wherein each of said return fiber lines is connected to all output couplers within respective ones of said sensor groups; and

wherein coupling ratios of said input couplers and said output couplers are chosen to reduce differences in the returned optical signal power levels, said input couplers in a first sensor group having a first input coupling ratio and said input couplers in a second sensor group having a second input coupling ratio different from said first input coupling ratio;

wherein one or more signal sources, that comprise a first signal source, are coupled with respective ones of said m distribution lines, that comprise a first distribution line;

wherein said input couplers comprise a first input coupler and a second input coupler, wherein a first number of said input couplers are located on the first distribution line between the first signal source and said first input coupler, wherein the first number is greater than or equal to zero, wherein the coupling ratio of said first input coupler is based on the first number, wherein a second number of said input couplers are located between the first signal source and said second input coupler, wherein the coupling ratio of said second input coupler is based on the second number, wherein the second number is greater than the first number, wherein the coupling ratio of said second input coupler is larger than the coupling ratio of said first input coupler;

wherein each output coupler is connected to a respective return fiber line from a sensor group having a coupling ratio that differs from the coupling ratio of the other output couplers connected to the respective return fiber line, wherein said output couplers comprise a first output coupler and a second output coupler, wherein a first number of said output couplers are located between said first output coupler and a signal destination on one of said return fiber lines, wherein the first number is greater than or equal to zero, wherein the coupling ratio of said first output coupler is based on the first number, wherein a second number of said output couplers are located between said second output coupler and the signal destination on the one of said return fiber lines, wherein the coupling ratio of said second output coupler is based on the second number, wherein the second number is greater than the first number, wherein the coupling ratio of said second output coupler is larger than the coupling ratio of said first output coupler, said input coupling ratios and said output coupling ratios selected in accordance with respective locations of said input couplers on said distribution fiber lines and respective locations of said output couplers on said return fiber lines.

9. (Once amended) The m × n sensor array as defined in Claim 1, ~~wherein the coupling ratios of each output coupler in each of said n sensor groups is selected in accordance with a respective location of each output coupler on the return fiber line~~wherein the coupling ratio of any one of said output couplers is based on a number of said output couplers located between the any one of said output couplers and a signal destination on one of the said n return fiber lines that corresponds to the any one of said output couplers.

10. (Once amended) The m × n sensor array as defined in Claim 1, ~~wherein the coupling ratios of said input couplers are selected in accordance with respective locations of said input couplers on said distribution fiber lines,~~wherein the coupling ratio of any one of said input couplers is based on a number of said input couplers located between the any one of said input couplers and a signal source on one of the said m distribution fiber lines that corresponds to the any one of said input couplers. ~~and wherein the coupling ratio of said input couplers in at least one of said n sensor groups are different from the coupling ratio of said input couplers in another of said n sensor groups.~~

Please add claims 13-24 as follows:

13. (New) The array of claim 1, wherein the coupling ratios of said input couplers in said z sensor groups and the coupling ratios of said output couplers in said sensor array serve to cause all the returned optical signal power levels to be within a preselected variance range.

14. (New) The array of claim 1, wherein y is greater than or equal to m.

15. (New) The array of claim 1, wherein a multiplicative product of m and n is equal to a multiplicative product of z and y.

16. (New) The array of claim 1, wherein one or more distribution fiber lines of the m distribution fiber lines are each coupled with two or more corresponding non-adjacent instances of the sensors.

17. (New) The array of claim 2, wherein z is 16 and y is 6.

18. (New) The array of claim 2, wherein z is 8 and y is 12.

19. (New) The array of claim 9, wherein the coupling ratio of the any one of said output couplers varies directly with the number of said output couplers located between the any one of said output couplers and the signal destination that corresponds to the any one of said output couplers.

20. (New) The array of claim 4, wherein the coupling ratios of said input couplers and the coupling ratios of said output couplers in said sensor array serve to cause all the returned optical signal power levels to be within a pre-selected variance range.

21. (New) An m × n sensor array, comprising:

m distribution fiber lines;

n return fiber lines; and

z sensor groups, each of said z sensor groups comprising:

y sensors; and

input couplers and output couplers, said input couplers and said output couplers being connected to respective ones of said sensors, each of said input couplers within any one of said z sensor groups being connected to a different one of said m distribution fiber lines;

wherein each of said return fiber lines is connected to all output couplers within a respective one of said z sensor groups; and

wherein coupling ratios of said input couplers in said z sensor groups and coupling ratios of said output couplers in said sensor array are chosen to reduce differences in the returned optical signal power levels, wherein said input couplers comprise a first input coupler and a second input coupler, wherein a first number of said input couplers are located between a signal source and said first input coupler on one of said m distribution lines, wherein the first number is greater than or equal to zero, wherein a second number of said input couplers are located between the signal source and said second input coupler on the distribution line, wherein the second number is greater than the first number, wherein the input coupling ratio of said second input coupler is higher than the input coupling ratio of said first input coupler.

22. (New) An m × n sensor array, comprising:

m distribution fiber lines;

n return fiber lines; and

z sensor groups, each of said z sensor groups comprising:

y sensors; and

input couplers and output couplers, said input couplers and said output couplers being connected to respective ones of said sensors, each of said input couplers within any one of said z sensor groups being connected to a different one of said m distribution fiber lines;

wherein the n return fiber lines comprise one or more sets of said n return fiber lines, wherein a first one of each set of said n return fiber lines is connected to a first subset of said output couplers within a respective one of said z sensor groups, wherein a second one of each set of said n return fiber lines is connected to a second subset of said output couplers within the respective one of said z sensor groups;

wherein coupling ratios of said input couplers in said z sensor groups and coupling ratios of said output couplers in said sensor array are chosen to reduce differences in the returned optical signal power levels, wherein the coupling ratios of said output couplers connected to a respective return fiber line are different from each other; and

wherein said output couplers comprise a first output coupler and a second output coupler, wherein a first number of said output couplers are located between said first output coupler and a signal destination on one of said n return fiber lines, wherein the first number is greater than or equal to zero, wherein the coupling ratio of said first output coupler is based on the first number, wherein a second number of said output couplers are located between said second output coupler and the signal destination on the one of said n return fiber lines, wherein the coupling ratio of said second output coupler is based on the second number, wherein the second number is greater than the first number, wherein the coupling ratio of said second output coupler is larger than the coupling ratio of said first output coupler.

23. (New) The array of claim 22, wherein the one or more sets of said n return fiber lines comprise one or more pairs of said n return fiber lines, wherein a first one of each pair of said n return fiber lines is connected to the first subset of said output couplers within the respective one of said z sensor groups, wherein a second one of each pair of said n return fiber lines is connected to the second subset of said output couplers within the respective one of said z sensor groups.

24. (New) The array of claim 22, wherein one or more return fiber lines of said n return fiber lines are each coupled with two or more corresponding non-adjacent instances of the y sensors.

Remarks

Entry of the above-noted amendments, reconsideration of the application, and allowance of all claims pending are respectfully requested. By this amendment, claims 1, 4, and 9-10 are amended, and claims 13-24 are added, to more particularly point out and distinctly claim the subject matter which applicants regard as the invention. These amendments to the claims constitute a bona fide attempt by applicants to advance prosecution of the application and obtain allowance of certain claims, and are in no way meant to acquiesce to the substance of the rejections. The specification has been amended to correct typographical errors. Support for the amendments can be found throughout the specification (e.g., page 3, lines 3-14, page 4, line 27, to page 5, line 10, page 5, line 27, to page 6, line 9, page 6, lines 10-29, page 7, line 25, to page 8, line 15, page 8, lines 5-11, page 8, lines 18-28), drawings (e.g., FIGS. 1, 2A-2H, 3, 4A-4H, and 5), and claims and thus, no new matter has been added. Claims 1-24 are pending.

Request for Change of Correspondence Address:

A request was filed on May 20, 2002 to kindly change the attorney correspondence address as follows:

Grossman, Patti & Brill
Customer Number 32205

Entry of this change is respectfully requested.

Request for Change of Attorney Docket No.:

Kindly change the Attorney Docket No. to:

LIT-124/GCD 98-25 N00

Entry of this change is respectfully requested.

Claim Rejections - 35 U.S.C. §112, first paragraph:

Claims 1-3, and 9-12 are rejected under 35 U.S.C. §112, first paragraph, because the specification, while being enabling for a 6×16 sensory array, allegedly does not reasonably enable an m×n sensory array. This rejection is respectfully, but most strenuously, traversed.

At least four examples of an m×n sensory array are enabled by the specification:

a 6×16 sensory array having 16 sensor groups, 6 sensors per group, with exemplary description at page 6, line 10, to page 7, line 12, and in FIGS. 2 and 2A-2H;

a 6×16 sensory array having 8 sensor groups, 12 sensors per group, with exemplary description at page 8, line 3, to page 9, line 4, and in FIGS. 4 and 4A-4H;

an m×n sensory array having n sensor groups and 2m sensors per group, with exemplary description at page 3, lines 3-14; and

a 6×1 sensory array having 1 sensor group, 6 sensors per group, with exemplary description at page 5, lines 5-7.

Withdrawal of the §112 rejection is therefore respectfully requested.

Double Patenting:

Applicants submit herewith an executed Terminal Disclaimer to Obviate A Double Patenting Rejection Over a Prior Patent PTO/SB/26, citing U.S. Patent No. 6,249,622 which is commonly-owned with the subject application.

Withdrawal of the double patenting rejection is therefore respectfully requested.

Remaining Claim Rejections - 35 U.S.C. §103:

Claims 1-12 are rejected under 35 U.S.C. §103(a) as being unpatentable over Frederick (U.S. Patent No. 5,696,857) in view of Hodgson, et al. (U.S. Patent No. 5,866,898; "Hodgson '898"). This rejection is respectfully, but most strenuously, traversed.

The subject application discloses, for example, use of couplers with progressively larger coupling ratios based on number of other couplers between a coupler and the signal source or destination. The coupling ratio of the output coupler is larger for each coupler between the output coupler and the signal destination (page 5, line 27, to page 6, line 9). The larger coupling ratio for couplers further from the signal source allows the designer to create a sensor array that minimizes the differences in optical return powers from each sensor, and to be within a specific variance range, for example, 7 dB (page 7, line 31, to page 8, line 2).

Frederick (col. 3, lines 32-34) discloses use of coupler with identical coupling ratios. Frederick teaches a wavelength/frequency division multiplexer (WDM/FDM) fiber optic sensor array system wherein the sensor array system comprises a plurality of sensor groups, each sensor having a plurality of sensors. In a sensor array, as a signal passes through a coupler the coupling ratio determines the percentage of the signal that the coupler will take from the fiber line. When

many couplers are passed on a fiber line the signal is reduced to a fraction of its former strength. If the returned signal powers are desired to be in a similar range of variance without using amplifiers, then a need exists to modify the sensor array to balance the amount of power each coupler takes from the fiber line.

Hodgson '898 (col. 8, lines 8-27) discloses identical coupling ratios of 10% while describing the loss of source signal. Hodgson '898 describes that when using constant coupling ratios throughout the array, the 100th sensor would receive 0.0003% of the source signal, while the first sensor would receive 10% of the source signal. The returned output power of the first sensor would be 0.01% of the original signal, and the returned optical power of the 100th sensor would be 0.0000000009% of the original signal. This is a difference of about 70 dB (10 log (P1/P2)).

Using larger coupling ratios for couplers further from the signal source/destination, as disclosed in the subject application, serves to narrow the differences between returned powers to a designed set range, for example, 7 dB. Furthermore, the subject application discloses a sensor array with single distribution line with an input coupler for each sensor in any given group. Frederick (col. 4, lines 54-56) discloses use of FDM/WDM to interrogate more sensors with fewer telemetry lines, and to minimize the array diameter (col. 5, lines 54-59). Hodgson '898 (col. 7, lines 42-61) discloses a sensor array system with only one distribution return bus, and one return bus. The subject application (e.g., page 4, lines 15, to page 5, line 10) discloses the use of m distribution fiber lines and n return fiber lines, to service z sensor groups containing y sensors each. Where each sensor in the array has a unique distribution and return line pair (e.g., page 6, lines 10-15).

The use of multiple distribution and return lines can be modeled as a defense against fiber breakage. Since each sensor in the array has a unique distribution and return fiber pair, if one fiber breaks it minimizes the loss of information (page 8, lines 5-11). Useful information can still be obtained from each area of the array. In one example of the array of FIGS. 2A-2H, if a distribution line breaks, every group will still return results. If a return line breaks, every group but one will still be producing results. In another example of the array of FIGS. 4A-4H, if a distribution or return line breaks, no two adjacent sensors will be affected (page 8, lines 18-28). The subject application discloses advantageous use of m distribution fiber lines and n return fiber lines, to service z sensor groups containing y sensors.

The independent claims presented herewith serve to particularly point out and distinctly recite features of the patent application that are believed neither anticipated nor obvious over the art of the record. The dependent claims are believed allowable for the same reasons as the independent claims, as well as for their own additional characterizations.

Withdrawal of all remaining rejections is therefore respectfully requested.

In view of the above amendments and remarks, allowance of all claims pending is respectfully requested. If a telephone conference would be of assistance in advancing the prosecution of this application, the Examiner is invited to call applicants' attorney.

Respectfully submitted,

Robert J. Brill

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Dated: June 6, 2002

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